ALASKA OREGON WASHINGTON

PACIFIC N W FOR EXP

USDA FOREST SERVICE RESEARCH NOTE

PNW-322

October 1978

# BIG HUCKLEBERRY ABUNDANCE AS RELATED TO ENVIRONMENT AND ASSOCIATED VEGETATION NEAR MOUNT ADAMS, WASHINGTON

by

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ABSTRACT

Big huckleberry abundance was correlated with associated vegetation and soil pH in a 625 square kilometer (241 square mile) area southwest of Mount Adams, Washington. Annual berry production appeared to be influenced by weather more than by site factors in this area. Douglas-fir site index was not correlated with either *Vaccinium membranaceum* abundance or berry production.

KEYWORDS: Huckleberries, *Vaccinium membranaceum*, ecology (plant), indicator plants, soil pH, climate (-plant adaptation.

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Many mountain huckleberry fields in northwestern America are declining as forest trees invade the old burns that provided suitable conditions for huckleberry production early in this century (Minore 1972). Modern fire control techniques have all but eliminated large wildfires in recent decades, and the dwindling areas now suitable for big huckleberry (*Vaccinium membranaceum* Doug. ed Hook.), the most frequently picked species, appear insufficient to maintain the huckleberry resource. If this resource is to be preserved, some forest land should be managed for huckleberries, but only where optimum environments occur. Huckleberry management may be costly, and it should be concentrated on the areas best suited to *V. membranaceum* growth and berry production.

Emmett and Ashby (1934) studied the relationships between soil pH and distribution of *Vaccinium myrtillus* in Britain, only to conclude that their data represented the distribution of acidity in random soil samples rather than the effects of pH on species occurrence. Lilly et al. (1972) compared adjacent areas and found that soil profile characteristics influencing soil moisture status differed between successful and unsuccessful sites, but their conclusions applied only to cultivated highbush blueberries grown in North Carolina. Unfortunately, optimum environments for growth of *V. membranaceum* have not been identified or described.

If meaningful conclusions are to be obtained for *V. membranaceum*, western huckleberry environments should be studied and compared. Some of the most heavily used huckleberry fields in the Northwest are located near Mount Adams, Washington. We studied this area in 1976 and 1977, seeking answers to the following questions:

1. Can easily measured environmental factors and vegetation be correlated with the abundance and productivity of *V. membranaceum*? If they can, what are the correlations?

2. Are Douglas-fir site quality and *Vaccinium* abundance or productivity related? If they are, do the best *V. membranaceum* areas occur on high or low quality forest land?

## METHODS

*Vaccinium membranaceum* environments and associated vegetation were sampled within a 625-square-kilometer[1/] area approximately 25 kilometers southwest of Mount Adams. Located in the Mount Adams District, Gifford Pinchot National Forest, the area includes a variety of soils, vegetation types, and landforms. Sample plots were established at 30 locations chosen to represent a wide range of slope, aspect, elevation, and vegetative conditions. Each plot consisted of sixteen 4-square-meter circular subplots spaced 20 meters apart to sample an area of 0.65 hectares. The sample plots all supported *V. membranaceum*. None were disturbed by logging. There was great variation among plots; but soil, aspect, slope, and vegetation were homogeneous within each plot.

On each sample plot, 13 variables were measured: average aspect azimuth, elevation, slope percent, overstory canopy density, stone cover, stone frequency percent, species presence of all seed plants, species cover percent, species frequency percent, soil pH, silt + clay percent, total nitrogen percent, and acetate exchangeable iron. Because azimuth degrees are poor quantitative expressions of aspect (1° and 359° represent almost identical aspects), aspect azimuths were coded for regression

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1/ English equivalents are given on page 8.

analyses. Coding was accomplished by determining an optimum aspect according to the procedure described by Stage (1976). This optimum value then was used with the aspect transformation equation published by Beers et al. (1966). Overstory canopy densities were measured on each subplot with a spherical densiometer, then averaged for the plot. Cover and frequency percentages for each plot also were based on individual subplot data. Soil analyses were performed in the laboratory on plot samples comprised of blended subsamples collected at 25-centimeter depths from four diagonal subplots in each plot. Where Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) trees were available, site indices were obtained from total height, age at breast height, and the curves of Curtis et al. (1974).

As plots were established and measured in July and August 1976, each subplot center was flagged. All 30 plots (480 subplots) were revisited in September 1976. Berry production was measured during this second visit; all green and ripe *V. membranaceum* berries within each subplot boundary were picked and combined for each plot. The berries from each plot were labeled, refrigerated, and taken to the laboratory for weighing. Because *V. membranaceum* berries ripened irregularly on every plot and the berries were at different phenological stages in the differing plot environments, all weights of harvested berries were converted to ripe weights. Several hundred randomly selected ripe berries from each plot were weighed and counted to obtain an average weight per ripe berry for that plot. Similarly, a random sample of all berries (ripe and green) from the same plot were counted and weighed to obtain an average weight per berry for all berries harvested. Ripe weight for each plot was then calculated; these calculated weights were used as measures of 1976 *V. membranaceum* berry production on the sample plots.

Plot vegetation was classified into plant communities by using species cover data. Species presence (occurrence on one or more subplots) and frequency (number of subplots supporting species times 100 divided by 16) were used to calculate indices similar to those of Warner and Harper (1972).

In calculating species indices for *V. membranaceum* abundance, we ranked the 30 plots by *V. membranaceum* cover percent, then divided them into three equal groups: high, low, and intermediate. The high and low groups were compared in terms of associated species presence, species by species. (Where identification of individual species was difficult late in the season, as with some grasses, genera were used.) The species differing most between high and low groups were selected as indicators and assigned numerical values based on the magnitude of these differences (table 1). Of the 57 species compared in this way, 13 were selected (table 2).

In calculating indices for 1976 berry production, we ranked the 30 plots by weights of ripe berries, then divided them into heavy, light, and intermediate groups. The heavy and light groups were compared in terms of species presence and frequency. As with the abundance index, the species differing most between heavy and light groups were selected as indicators and assigned numerical values based on the magnitude of these differences. Twelve species were selected for a productivity index based on frequency. Indices based on presence were calculated by averaging the values of all indicator species persent on a plot. Indices based on frequency were calculated by Warner and Harper's (1972) procedure.

Table 1--*Example of indicator species selection and value determination for the* Vaccinium membranaceum *abundance index*[1/]

| Species | Number of plots supporting species | | High minus low | Indicator value |
|---|---|---|---|---|
| | High group | Low group | | |
| *Achlys triphylla* | 2 | 4 | -2 | -- |
| *Anemone deltoidea* | 3 | 2 | 1 | -- |
| *Pachystima myrsinites* | 7 | 1 | 6 | 12 |
| *Pinus contorta* | 5 | 8 | -3 | 3 |
| *Rumex acetosella* | -- | 5 | -5 | 1 |
| *Sorbus scopulina* | 7 | 2 | 5 | 11 |
| *Tsuga mertensiana* | 8 | 6 | 2 | -- |
| *Xerophyllum tenax* | 10 | 10 | 0 | -- |

[1/]The number of plots supporting the species in the group of 10 high *Vaccinium* cover plots was compared with the number of plots supporting the species in the group of 10 low *Vaccinium* cover plots. Species with differences of 2 or less (e.g., *Achlys, Anemone, Tsuga,* and *Xerophyllum*) were rejected. Species with differences of 3 or more (e.g., *Pachystima, Pinus, Rumex,* and *Sorbus*) were selected and assigned indicator values determined by relative differences in presence. Negative differences were converted to positive values by adding 6 to all differences.

Table 2--*Indicator species and values used in calculating* Vaccinium membranaceum *abundance indices*[1/]

| Species | Indicator value |
|---|---|
| *Pachystima myrsinites* | 12 |
| *Sorbus scopulina* | 11 |
| *Abies lasiocarpa* | 10 |
| *Aster* spp. | 10 |
| *Penstemon* spp. | 10 |
| *Epilobium angustifolium* | 9 |
| *Lupinus* spp. | 9 |
| *Pinus contorta* | 3 |
| *Vaccinium ovalifolium* | 3 |
| *Festuca* spp. | 3 |
| *Spirea* spp. | 2 |
| *Agoseris heterophylla* | 2 |
| *Rumex acetosella* | 1 |

[1/]Index value is the average of the values of all indicator species present on a given plot.

The environmental and vegetative parameters measured on each of the 30 plots were treated as independent variables in two stepwise multiple regression analyses, with *V. membranaceum* ripe berry weight as the dependent variable in one analysis, *V. membranaceum* cover percent as the dependent variable in the other. Significant variables were combined in regression equations

relating them to 1976 berry production and abundance of *V. membranaceum* on the areas sampled. Simple regression analyses were used in investigating Douglas-fir site index--*Vaccinium* abundance relationships on plots supporting Douglas-fir site trees.

## RESULTS

Elevations ranged from 914 to 1 570 meters in the study area. Slopes varied from 2 to 53 percent, and aspects were well districuted from 4° through 352°. Overstory canopy densities ranged from 4 to 91 percent. Ripe weights of the berries harvested in September 1976 varied from 1 to 4 080 grams per plot (0.15 to 630.12 kilograms per hectare). When these ripe weights were converted to equivalent volumes, the highest yielding plot produced 935 liters per hectare. Huckleberries were marketed at $2 to $3 per liter in 1976, so economic yield on the best area would have been over $1,870 per hectare if all berries had been picked. Big huckleberry cover varied from 5 to 63 percent on the sample plots.

On the 30 plots, eight plant communities were recognized. When plots were classified by these plant communities and the resulting groups compared in terms of berry production and *V. membranaceum* cover percent, variation within community groups was almost as great as variation among groups (table 3). *Abies lasiocarpa/ V. membranaceum/Xerophyllum* may represent an optimum huckleberry community, but no consistent relationships are evident.

Table 3--*Plant communities as related to* Vaccinium membranaceum *berry production and cover*

| Plant community[1] | Number of plots | Average weight of ripe berries | Range in ripe weights | Average *V. membranaceum* cover | Range in cover |
|---|---|---|---|---|---|
| | | - Kilograms per hectare - | | - - - Percent - - - | |
| *Abies lasiocarpa/ V. membranaceum/ Xerophyllum* | 5 | 231 | 139-313 | 52 | 36-63 |
| *Abies amabilis/ V. membranaceum/ Rubus lasiococcus* | 4 | 286 | 17-630 | 40 | 32-47 |
| *Abies amabilis/ V. membranaceum/ Erythronium montanum* | 3 | 115 | 12-303 | 38 | 36-41 |
| *Pinus contorta/ V. membranaceum/ Xerophyllum* | 4 | 88 | 5-252 | 32 | 12-55 |
| *Pinus contorta/ V. membranaceum/ Lupinus-Carex* | 5 | 135 | 0-574 | 28 | 8-48 |
| *Pseudotsuga/ V. membranaceum/ Xerophyllum* | 6 | 55 | 3-126 | 48 | 38-55 |
| *Pseudotsuga/ V. membranaceum/ Linnaea* | 2 | 43 | 38-49 | 35 | 25-45 |
| *Tsuga-Thuja/ V. alaskaense- V. ovalifolium/ Cornus canadensis- Linnaea* | 1 | 6 | -- | 5 | -- |

[1]These communities are comprised of the dominant species as indicated by cover estimates on each plot. Plots with similar dominants were grouped.

When subjected to regression analyses, elevation, aspect, and the productivity index based on species presence were well correlated with 1976 berry production ($r^2 = 0.77$). Berry production, however, is often influenced by meteorological factors that vary from year to year. Therefore, we tested our equation by picking berries from additional plots in 1977. Although a light snowpack during the winter of 1976-77 affected berry production, green berries were abundant in July. Unfortunately, a severe hailstorm swept erratically through the study area early in August 1977. Many study plots were denuded; others were undamaged. As a result, the regression equation developed from 1976 data was not applicable to 1977 berry production.

Fortunately, *V. membranaceum* shrub abundance (cover percent) is less influenced by meteorological factors. Unlike berry production, shrub cover remains quite constant from year to year. Two of the regression variables were significantly correlated with *V. membranaceum* cover--soil pH and the abundance index described in tables 1 and 2. When expressed in a multiple regression equation, these correlations accounted for more than half the cover variation among plots:

$$VMC\% = -1.302.79 + 5.0074(AI) + 475.815(pH) - 43.1596(pH^2),$$

$$r^2 = 0.602, \text{ and}$$

$$\text{standard error of estimate} = 9.74;$$

where VMC% = *V. membranaecum* cover percent,
AI = abundance index,
pH = soil pH.

The calculated relation of pH to VMC% at three AI values is shown in figure 1. When this equation is used, the resulting optimum soil pH for *V. membranaceum* cover is 5.5.

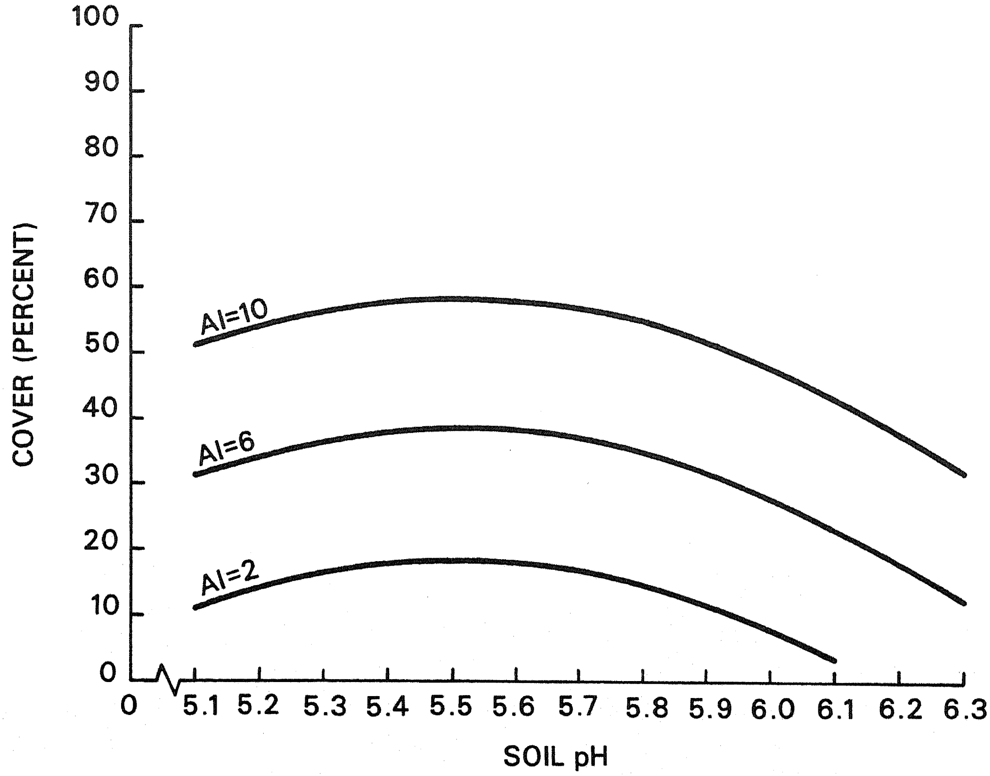


*Figure 1.--Calculated relation of soil pH to* Vaccinium membranaceum *cover at three abundance indices (AI). Calculated from VMC% = -1.302.79 + 5.0074(AI) + 475.815(pH) − 43.1596(pH²); r² = 0.602).*

None of the other measured environmental variables were sufficiently correlated with *Vaccinium* cover to have significant coefficients in the multiple regression analysis. Separate analyses of 17 plots with Douglas-fir site trees showed no correlation of *Vaccinium* cover or berry production with Douglas-fir site index.

## DISCUSSION

Unmeasured meteorological influences apparently are more important than local environmental factors in determining annual berry production, and one or two annual berry crops cannot be used to assess the relative favorability of *V. membranaceum* areas. Depth and duration of the previous winter snowpack, the occurrence of killing frosts, and erratic phenomena like the 1977 hailstorm often obscure the effects of soil, topography, and elevation on berry production in any given year. Meteorological influences are less important in determining huckleberry cover.

*Vaccinium* cover and berry production are influenced by vegetative succession, however, and suitable environments produce abundant *V. membranaceum* cover only at optimal seral stages. Conversly, optimal seral stages result in abundant cover only in suitable environments. As our association indices are strongly influenced by both succession and local environment, a low AI does not necessarily indicate a poor *V. membranaceum* area--it may reflect a pre- or post-*Vaccinium* stage in succession. Nevertheless, a high AI occurs only at a favorable seral stage on a good area, and it can be used to identify favorable areas in the Mount Adams vicinity.

Soil pH is less affected by succession than the abundance index, and it is significantly related to *Vaccinium* cover. When the regression equation derived from our data is used, the calculated relationship is curvilinear, with an optimum value of 5.5 for all abundance indices (fig. 1). This field observation agrees with the greenhouse observations of Nelson (1974), who found that *V. membranaceum* seedlings grew better at pH 5 than at 3, 4, or 6. Land managers involved in huckleberry management would do well to concentrate their efforts on areas having soil pH values near 5.5. They should choose successional stages having high AI values on these areas.

*V. membranaceum* abundance, expressed as cover percent, should be a good indicator of area favorability for the species. All other things being equal, good areas have more *Vaccinium* cover than poor areas. Furthermore, areas with more *Vaccinium* cover should produce more berries than those with less cover when annual weather phenomena are averaged over many years.

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## ENGLISH EQUIVALENTS

| | |
|---|---|
| 1 centimeter = | 0.3937 inch |
| 1 gram = | 0.035 ounce |
| 1 hectare = | 2.4710 acres |
| 1 kilogram = | 2.2046 pounds |
| 1 kilogram per hectare = | 5.4477 pounds per acre |
| 1 kilometer = | 0.62137 mile |
| 1 square kilometer = | 0.3861 square mile |
| 1 liter = | 0.2642 gallon |
| 1 liter per hectare = | 0.1069 gallon per acre |
| 1 meter = | 3.2808 feet |
| 1 square meter = | 10.7639 square feet<br>0.0002471 acre |



GPO 987-009